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Development of Oceanographic Sampling Networks Using Autonomous Gliding Vehicles

David M. Fratantoni
Physical Oceanography Department
Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Phone: (508) 289-2908 Fax: (508) 457-2181 Email: dfratantoni@whoi.edu

Grant #: N00014-00-1-0256
http://glider.whoi.edu

LONG-TERM GOALS

Our long-term goal is to develop an efficient, relocatable, infrastructure-free ocean observing system composed of high-endurance, low-cost gliding vehicles with near-global range and modular sensor payload. Particular emphasis is placed on the development of adaptive sampling strategies and the automated control of large glider fleets operating within the framework of an autonomous oceanographic sampling network.

OBJECTIVES

The primary objective of this program is to demonstrate moderate-term (weeks to months) operation of multi-vehicle autonomous glider networks in blue-water environments. Secondary objectives include continued improvement of multi-vehicle communication and control systems and the development, implementation, and field-testing of adaptive sampling algorithms and sensor intercalibration schemes.

APPROACH

We are collaborating on the development and field-testing of both battery- and environmentally-powered gliders constructed by Webb Research Corporation. In addition, we are continuing to develop multi-vehicle control and management systems using conventional battery-powered gliders and computer simulations.

WORK COMPLETED

Initial sea trials of an environmentally-powered glider were be performed in the Bahamas (Tongue of the Ocean) during winter 2002-2003. After analyzing the results of these trials a next-generation prototype has been designed and is presently under construction. This vehicle will be tested at sea during winter 2003-2004. Major improvements include addition of a servo-controlled rudder for improved lateral control and reallocation of internal volume.

We have completed the development of an integrated glider data management system. This system is now in routine use in our laboratory and has been linked with a web-based front-end for near-real-time data distribution via the internet for integration with assimilating numerical models. We have developed a desktop-based mission simulator which allows efficient prototyping of adaptive sampling algorithms and multiple-vehicle interaction with arbitrary, realistic environmental forcing (winds, tides, currents, etc.). Iridium satellite phone is now the primary means of bidirectional vehicle-to-shore communications. The system is robust and capable of providing truly global operation of autonomous networks.

RESULTS

Operations in Tongue of the Ocean (Bahamas) and Buzzards Bay (MA) during winter 2002-2003with one environmentally-powered vehicle and three battery-powered vehicles yielded approximately 350 total hours of automated network operation and nearly 3000 vertical profiles of temperature and salinity. Improvements to glider hardware and software stemming from these field operations have resulted in a network control system which is now ready for operational scientific use.

IMPACT/APPLICATIONS

Continued development of multi-vehicle network operations will enable efficient measurement of transient ocean phenomena such as mesoscale eddies and fronts and streamline distributed environmental observations in remote or hostile locations. A network of gliding vehicles will supply, in an efficient and cost-effective manner, high-quality, near-real-time environmental information for operational ocean/atmosphere forecasting and model validation.

RELATED PROJECTS

Adaptive Oceanographic Sampling in a Coastal Environment using Autonomous Gliding Vehicles (D. M. Fratantoni, N00014-01-1-0340)

An Autonomous Glider Network for the Monterey Bay Predictive Skill Experiment / AOSN-II (D.M. Fratantoni, N00014-02-1-0846)